



# Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter<sup>1</sup>

This standard is issued under the fixed designation D 3035; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

1.1 This specification covers polyethylene (PE) pipe made in thermoplastic pipe dimension ratios based on outside diameter and pressure rated for water (see **Appendix X1**). Included are criteria for classifying PE plastic pipe materials and PE plastic pipe, a system of nomenclature for PE plastic pipe, and requirements and test methods for materials, workmanship, dimensions, sustained pressure, burst pressure, and environmental stress cracking. Methods of marking are also given.

1.2 All pipes produced under this specification may be used for the transport of water, industrial process liquids, effluents, slurries, municipal sewage, etc. The user should consult the manufacturer to determine whether the material being transported is compatible with polyethylene pipe and will not affect the service life beyond limits acceptable to the user.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- D 618 Practice for Conditioning Plastics for Testing
- D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
- D 1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

- D 1600 Terminology for Abbreviated Terms Relating to Plastics
- D 1603 Test Method for Carbon Black Content in Olefin Plastics
- D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D 2290 Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe by Split Disk Method
- D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
- F 412 Terminology Relating to Plastic Piping Systems
- 2.2 NSF International Standards:
  - ANSI/NSF Standard No. 14 for Plastic Piping Components and Related Materials<sup>3</sup>
  - ANSI/NSF Standard No. 61 for Drinking Water System Components—Health Effects<sup>3</sup>
- 2.3 PPI Documents:
  - TR-4 Listing of Hydrostatic Design Bases (HDB), Strength Design Bases (SDB), Pressure Design Bases (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe<sup>4</sup>
  - TR-9 Recommended Design Factors for Thermoplastic Pressure Pipe<sup>4</sup>

## 3. Terminology

3.1 Definitions—Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise specified.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *hydrostatic design stress*—the estimated maximum tensile stress in the wall of the pipe in the circumferential orientation due to internal hydrostatic water pressure that can be applied continuously with a high degree of certainty that failure of the pipe will not occur.

3.2.2 *pressure rating (PR)*—the estimated maximum pressure that water in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from the National Sanitation Foundation, P.O. Box 1468, Ann Arbor, MI 48106.

<sup>4</sup> Available from the Plastics Pipe Institute, Inc., 1825 Connecticut Ave., NW, Suite 680 Washington, DC 20009.

**TABLE 1 Specification D 3350 Cell Classifications for Polyethylene Pipe Materials**

PE Material Designation Code	PE 1404	PE 2606	PE 2708	PE 3608	PE 3708	PE 3710	PE 4608	PE 4708	PE 4710
Physical Property:	Cell Classifications								
Density	1	2	2	3	3	3	4	4	4
Melt Index	2	3 or 4	3 or 4	3 or 4	3 or 4	3 or 4	3 or 4	3 or 4	3 or 4
Flexural Modulus	3	3 or 4	3 or 4	4 or 5	4 or 5	4 or 5	4 or 5	4 or 5	4 or 5
Tensile Strength at Yield	1	3 or 4	3 or 4	4 or 5	4 or 5	4 or 5	4 or 5	4 or 5	4 or 5
Slow Crack Growth Resistance	1 <sup>A</sup>	6 <sup>B</sup>	7	6 <sup>B</sup>	7	7	6	7	7
Hydrostatic strength Classification	1	3	3	4	4	4	4	4	4
Color and UV Stabilizer <sup>C</sup>	C	C or E	C or E	C or E	C or E	C or E	C or E	C or E	C or E

<sup>A</sup> Test Method D 1693 ESCR.

<sup>B</sup> Test Method F 1473 PENT.

<sup>C</sup> Classification C compounds shall contain 2 to 3.5 % carbon black when tested in accordance with Test Method D 1603. Classification C and E compounds shall have sufficient antioxidants to meet requirements in Specification D 3350. Pipe produced from Classification E compounds is not suitable for continuous use in exposed outdoor applications. Classification E compounds shall have sufficient UV stabilizer to protect pipe from deleterious effects due to continuous outdoor exposure during shipping and unprotected outdoor storage for up to 18 months.

3.2.3 *relation between dimension ratio, hydrostatic design stress, and pressure rating*—the following expression, commonly known as the ISO equation,<sup>5</sup> is used in this specification to relate dimension ratio, hydrostatic design stress, and pressure rating:

$$2S/P = DR - 1 \text{ or } 2S/P = (D_o/t) - 1 \quad (1)$$

where:

*S* = hydrostatic design stress, psi (MPa),

*P* = pressure rating, psi (MPa),

*D<sub>o</sub>* = average outside diameter, in. (mm)

*t* = minimum wall thickness, in. (mm), and,

*DR* = thermoplastic pipe dimension ratio (*D<sub>o</sub>/t* for PE pipe).

3.2.4 *thermoplastic pipe dimension ratio (DR)*—the ratio of pipe diameter to wall thickness. For PE pipe covered by this specification it is calculated by dividing the average outside diameter of the pipe, in inches, by the minimum wall thickness, in inches. If the wall thickness calculated by this formula is less than 0.062 in. (1.6 mm), it shall be arbitrarily increased to 0.062 in.

3.2.5 *thermoplastic pipe materials designation code*—the polyethylene pipe materials designation code shall consist of the abbreviation PE for the type of plastics, followed by the ASTM grade in Arabic numerals and the hydrostatic design stress in units of 100 psi with any decimal figures dropped. Where the hydrostatic design stress code contains less than two figures, a zero shall be used before the number. Thus, a complete material code shall consist of two letters and four figures for PE plastic pipe materials (see Section 5).

## 4. Pipe Classification

4.1 *General*—This specification covers PE pipe made from PE plastic pipe materials in various dimension ratios and water pressure ratings.

4.2 *Thermoplastic Pipe Dimension Ratios (DR)*—This specification covers PE pipe in various dimension ratios such as, but not limited to, DR 11, DR 13.5, DR 17, and DR 21. The pressure rating is uniform for all nominal sizes of pipe for a given PE pipe material and DR. (See Table X1.1.)

<sup>5</sup> ISO R 161-1960, Pipes of Plastics Materials for the Transport of Fluids (Outside Diameters and Nominal Pressure), Part 1, Metric Series.

**TABLE 2 Outside Diameters and Tolerances for DR-PR PE Plastic Pipe**

Nominal Pipe Size, in.	Outside Diameter, in. (mm)	Tolerances, in. (mm)
½	0.840 (21.34)	±0.004 (0.10)
¾	1.050 (26.7)	±0.004 (0.10)
1	1.315 (33.4)	±0.005 (0.13)
1¼	1.660 (42.2)	±0.005 (0.13)
1½	1.900 (48.3)	±0.006 (0.15)
2	2.375 (60.3)	±0.006 (0.15)
3	3.500 (88.9)	±0.008 (0.20)
4	4.500 (114.3)	±0.009 (0.23)
6	6.625 (168.28)	±0.011 (0.28)
8	8.625 (219.08)	±0.013 (0.33)
10	10.750 (273.05)	±0.015 (0.38)
12	12.750 (323.85)	±0.017 (0.43)
14	14.000 (355.60)	±0.063 (1.60)
16	16.000 (406.40)	±0.072 (1.83)
18	18.000 (457.20)	±0.081 (2.06)
20	20.000 (508.00)	±0.090 (2.29)
22	22.000 (558.80)	±0.099 (2.51)
24	24.000 (609.60)	±0.108 (2.74)

4.3 *Special Sizes*—Where existing system conditions or special local requirements make other diameters or dimension ratios necessary, other sizes or dimension ratios, or both, shall be acceptable in engineered products when mutually agreed upon by the customer and manufacturer if (1) the pipe is manufactured from plastic compounds meeting the material requirements of this specification and (2) the strength and design requirements are calculated on the same basis as those used in this specification.

## 5. Materials

5.1 *Classification*—Polyethylene compounds suitable for use in the manufacture of pipe under this specification shall be classified in accordance with Specification D 3350 and as shown in Table 1.

NOTE 1—Piping intended for use in the transport of potable water should be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority. The evaluation should be in accordance with requirements for chemical extraction, taste, and odor that are no less restrictive than those included in ANSI/NSF Standard No. 14 or ANSI/NSF Standard No. 61. The seal or mark of the laboratory making the evaluation should be included on the piping.

NOTE 2—Pipe users should consult with the pipe manufacturer about the outdoor exposure life of the product under consideration.

